

ARTESIAN WATER

It seems unlikely that the sandstone members in the shale series under Guantánamo basin contain any large amount of water that would rise to or above the surface. These members are thin, mostly muddy and have very small outcrop areas but it is possible that in some places they might afford a local supply. It seems likely however, that there is some chance for water in the conglomerate near the Naval Station where the coarse deposits probably abut against the schists. It is also possible that if the 1400-foot hole south of Boqueron had been deeper it might have reached coarse beds containing water.

BOTANY.—*New species of cotton plants from Sonora and Sinaloa, Mexico.* O. F. COOK and J. W. HUBBARD, Bureau of Plant Industry.¹

A brief visit was made in December, 1925, to northwestern Mexico to study the native cottons and rubber-producing plants. In the vicinity of Guaymas two localities were visited where *Gossypium davidsonii* grew in abundance along dry washes and in open shrubby vegetation, much as *Thurberia* grows in Arizona. Also several forms of the native door-yard cottons were obtained at Guaymas and in the Yaqui Valley, at Esperanza, Cocorit, and Cajeme.

Most of the data regarding the native cottons were obtained at Los Mochis, Sinaloa, between San Blas and Topolobampo. Several of the native species had been collected and a small planting made at Los Mochis by Dr. W. W. Morrill, formerly State Entomologist of Arizona, and more recently engaged in agricultural investigations in Mexico. Dr. Morrill had observed a wide range of differences among the native cottons, and invited us to make a botanical study of the collection that he had grown at Los Mochis. Also he suggested that we stop at Guaymas and in the Yaqui Valley, to see the other types of native cottons that he had noted in those districts.

The classification of the species of *Gossypium* presents several difficulties that are not apparent on the surface, but are more appreciated as wider knowledge and experience are gained. One of the chief difficulties is that the cotton plants and their relatives have a protean flexibility of response to different conditions of growth. Such changes of characters often extend beyond any reasonable prospect of associating the members of the same progeny, if the origin of the seed is not

¹ Received May 5, 1926.

definitely known. The size of the plants, the habits of growth, the forms, textures and surfaces of the leaves and involucral bracts; the sizes and shapes of the bolls, numbers of locks, and even the seed and lint characters, have been profoundly altered in some of the cottons brought from tropical countries, when planted for the first time in the United States.

Other difficulties in classification arise from differences of age and of seasonal or cultural conditions, complicated also by the variability and diversity that are usually to be found in the leaves and other organs of the same individual plant. The juvenile leaves are different from the adult leaves, the stalk leaves different from the branch leaves, and the sun leaves different from the shade leaves. Thus a very wide range of sizes, forms and textures of leaves, bracts, and bolls, may be found on any large plant. Yet with side by side comparisons of living plants and judicious selection of material, it becomes possible to recognize and formulate contrasting characters. Without such comparisons the characters remain too indefinite and intangible to be used for purposes of diagnosis.

Much of the herbarium material of *Gossypium* has been assembled with no recognition or purpose of showing the distinctive characters of the species, and the association of such material into species is largely speculative or arbitrary. The usual herbarium specimen is a part of a fruiting branch with a flower, but showing little of the range of characters, even of the leaves and involucres. The characters of the fresh unopened bolls, which afford some of the most distinctive features, are difficult to preserve, and usually disappear in the dried specimens.

Finally, the task of classification is complicated by the wealth of plant types, whether species, varieties, or hybrids, of which it is necessary to take account. Missionaries and traders have carried cotton seed to remote regions, so that many of the primitive tribes have obtained commercial cottons which now are variously hybridized with the native kinds. In addition to the principal commercial species and their numerous varieties, there undoubtedly are hundreds, if not thousands, of appreciably different forms of cotton in cultivation among the primitive tropical peoples of both hemispheres.

The conditions of existence for cotton plants no doubt were profoundly changed during the agricultural period of human development, in prehistoric times. With the spread of the primitive agricultural people over the tropical world, the forest areas were restricted and the

species of cotton that previously had been isolated were brought together and allowed to hybridize.

From the fact that cotton is not tolerant of shade, it may be inferred that the species were limited in their natural distribution to dry districts where other vegetation was sparse and open, either because the soil was too rocky or too sandy, or because the rainfall was too limited or too irregular to support large trees or a dense growth of forest. There may have been many separate areas where different wild species of cotton existed, and a few may still exist under conditions of natural isolation, like other wild plants.

How many species there were, before the agricultural period, it may be impossible to determine, or to establish definitely the original associations of the characters. The recognition of species necessarily is provisional in our present state of knowledge, but at least the differences that exist should be recognized, and the out-standing peculiarities that appear in the cotton plants of different regions should be recorded, as affording the best prospect of associating the characters correctly.

Although most of the West-Mexican cottons are to be associated with Watt's Section IV on account of the smooth seed, other characters are remote from those of the Sea Island series. These differences include the presence of distinct angular teeth on the calyx, in some cases produced into slender points, that may even project beyond the buds.

Another departure from the Sea Island series is in the form of the leaves, with the auricles very large, the sinus often completely closed and the lobes overlapping. In these respects there may be more affinity with some of the species of Watt's Section III, species with fuzzy seed and free bracts. Yet these Mexican cottons may be associated with the Sea Island series in the broadest sense, since their seeds are fuzzy only at the base and their bracts are somewhat united.

KEY TO MEXICAN COTTONS

Outer nectaries located on the pedicel, below the receptacle, forming a narrow groove on a longitudinal ridge; large leaves of uprights with broad flat lobes, the margins often distinctly undulate

Gossypium hypadenum

Outer nectaries located on the receptacle, in the sinus of the bracts; leaf-margins not undulate.

Invulcres open at the angles, the bracts small, oval, narrowed at the base, not auricled; pedicels swollen at the base, often slender, attaining more than 3 times the length of the mature bolls; fruiting branches short, usually of 1 or 2 slender internodes

Gossypium patens

Involucres usually closed at the angles; bracts cordate, auricled or expanded at the base, below the point of attachment; pedicels stout and short, seldom exceeding the length of the boll.

Bolls flat-sided, square or pyramidal, with no oil-glands over the sutures; the locks held compactly in the open bolls by numerous fibers attached to the carpel walls

Gossypium contextum

Bolls rounded in section; oil-glands not interrupted over the sutures; the cotton not held in the open bolls by fibers attached to the carpel walls

Plants producing a vegetative and a fruiting branch from most of the nodes on the upper part of the stalk; these vegetative branches horizontal, bearing many short fruiting branches; flowers white with large red petal-spots; bolls smooth, oblong-elliptic with a short abrupt beak.....*Gossypium dicladum*

Vegetative branches confined to lower nodes, large and ascending as secondary stalks; flowers white, with no petal-spots; bolls distinctly pitted, conic-ovoid, with a long acuminate point.....*Gossypium morrilli*

Gossypium hypadenum, new species

Plants with strong, upright shoots attaining a height of about 10 feet in the first season. Very young stems and margins of the bracts slightly pilose, but all adult parts appearing entirely naked.

Leaves of rather thin papery texture, light green, glabrescent, deeply cordate and auricled, entire or with 3 to 5 broadly triangular lobes, with long acuminate points, side lobes usually very short, often represented only by a tooth; callus red, even on young leaves; petioles held in erect or strongly ascending positions and at smaller angles to the blade than in other cottons; upper side of petiole with a sharp median crest or angle, more distinct on the upper pulvinus, but running well down. Leaves of the upright shoots attaining large size, with the margins undulate, or ruffled, contrasting with the flat surface; length of blade on midrib 17 cm., on the auricles 22 cm., width 24 cm., petiole 24 cm.; auricles very large, often overlapping. Leaf nectaries usually 3, those on midveins much farther up, often twice as far as those on the veins of the forelobes; stipules large and persistent.

Involucral bracts large, flat, deeply cordate and auricled, with 7 to 9 large, gradually tapering teeth, longer than the body of the bract; auricles regularly united on the margins at base almost to their full width; color of bracts light fresh green, sometimes reddened on the exposed side; bractlets not found; outer nectaries, a long narrow groove, simulating leaf nectaries, and located far down on a ridge of the pedicel, rather than in a depression of the receptacle; inner nectaries broadly triangular; no distinct swelling of the receptacle around the end of the pedicel as in the usual cotton types, where the nectaries usually are placed, but a gradual tapering down from the bolls, more like *Gossypium davidsonii*; calyx with long slender teeth, tailed, often exceeding the bud.

Flowers pale yellow, with no petal spots; stamens relatively few, with rather long filaments, anthers brownish, pollen very pale; stigma only slightly exerted.

Bolls rather small, elliptical, acuminate, 3-locked, with a band free of oil-glands along each suture, most of the oil glands being close to the fissures.

Type in the U. S. National Herbarium, no. 1,209,604, collected at Los Mochis, Sinaloa, Dec. 16, 1925, by O. F. Cook and J. W. Hubbard.

Gossypium patens, new species

A large branching shrub or small tree about 12 feet high, with trunk 3 or 4 inches in diameter. Fruiting branches short, practically one-jointed, the other joints very slender and seldom producing bolls. Usually the second joints diverge very strongly from the direction of the first on account of the swollen base of the pedicel.

Leaf forms showing a wide range of diversity; the large leaves of rather heavy texture, several inches across, of broad Upland forms; small leaves having distinct, somewhat attenuate lobes, suggesting Durango or Acala; also many simple, entire, subcordate leaves much like those of *Gossypium davidsonii*; petioles relatively short on the large leaves; stipules of vegetative branches long, linear, those of fruiting branches much shorter and broader.

Involucres small and open, the bracts oval, distinctly narrowed at base, flared at the angles; teeth 5 to 7, well forward, often none below the middle; bractlets usually present, double involucres of frequent occurrence; outer nectaries distinct, but small and uncolored, forming deep, round or short elliptic depressions in the strongly inflated surface of the receptacle; inner nectaries transverse, located in very deep grooves; pedicels often very long, 3 or 4 times the length of the boll, and with the base swollen as in *Thurberia*; some of the short pedicels much thicker than the internodes of the fruiting branches; calyx lobes with long attenuate tips often exceeding the bud, all five lobes tailed or only 3, with the others sharply angled.

Flowers white, no petal spots; stigma well exerted.

Bolls small, subrotund, abruptly apiculate, 2, 3, and 4 locked, usually 3; fissure deeply marked below, even in green bolls, extending completely to the receptacle; ripe open boll 3.5 cm. across, with beak about 5 mm. long, very distinct in dried state; seeds 4 or 5 in each lock.

Seed small, black, naked, except a small tuft of brown fuzz at beak; lint sparse, fine, silky, more than 1 inch in length, commonly $\frac{1}{8}$.

Type in the U. S. National Herbarium, no. 1,209,601, collected at Guaymas, Sonora, Dec. 8, 1925, by O. F. Cook and J. W. Hubbard.

Gossypium contextum, new species

A robust, spreading, bushy plant, with rather strong short-jointed stalks, hirsute branches and dense foliage.

Leaves heavy, deep green, densely pilose, entire or 3 to 5 lobed, deeply cordate and auricled, sinus often closed; an occasional tooth on the midlobe, or on the basal curves; leaves of the upright shoots attaining large size with very large auricles, often overlapping widely; length of blade on the midrib 20 cm., on the auricle 25 cm., width 27 cm., petiole 24 cm.; nectaries usually 3, even on rather small leaves; stipules present, but not prominent.

Involucral bracts deeply cordate, with long teeth, auricles united at the base; bractlets of common occurrence, often 3 together, usually 3 or 4 to an involucre; calyx with long triangular lobes, sometimes with tails as long as the bud.

Bolls of medium size, short and flat sided, pyramidal or square, with a short abrupt tip; oil-glands not present on a broad light green band over the suture; 3 or 4 locks, with 5 to 7 seed per lock.

Seed dark brown, smooth, with yellowish brown fuzz at base; lint rather sparse, from three-fourths to seven-eighths inches long, easily pulled from the seed, but strongly held in the locks by numerous fibers attached to the carpel walls.

Type in the U. S. National Herbarium, no. 1,209,602, collected at Los Mochis, Sinaloa, December 16, 1925, by O. F. Cook and J. W. Hubbard.

On account of the numerous fibers attached to the walls of the carpels; the open bolls of this species have a distinctive appearance, with the locks not emerging from the carpels, but somewhat drawn down from the opening and remaining a compact mass. This is in striking contrast with the behavior of the cotton in the open bolls of other species. In some cottons the locks remain in place, on account of the rough elastic fibre which "fluffs" and holds together. In other species the locks fall out soon after the bolls open, or the seeds separate gradually.

Gossypium dicladum, new species

A large, upright, densely foliated plant, with woody stems and hirsute leaves and branches, producing small horizontal vegetative branches from most of the joints to near the top of the plants, from the same nodes with the normal fruiting branches, and of about the same size, bearing bolls on small secondary fruiting branches, usually of 1 or 2 joints.

Leaves of medium size, cordate, entire or 3 to 5 lobed, with large forelobes nearly equal to the midlobe; length of blade on midvein 12 cm., on auricle 15 cm., width 18 cm., petiole 13 cm., extra teeth occasional on basal lobes, none on midlobe; auricles ample, often overlapping; texture rather heavy, brittle; nectaries usually one, near the base; stipules prominent and persistent on the young shoots.

Involucral bracts large, cordate, with rather large teeth, the auricles regularly united on the margins below to almost their full width; nectaries usually present; receptacles prominent and distinct; calyx with short sharp pointed lobes, but not tailed.

Flowers large, white, opening widely, with very large dark red spots on the claws of the petals; stamens numerous; anthers pale; stigma barely protruding beyond the staminal column.

Bolls oblong-elliptic, apiculate, 3 and 4 locked; oil-glands large and scattering; no distinct sutural bands without oil-glands.

Seed large, black, naked, except a tuft of greenish fuzz at beak; lint sparse, three-fourths to seven-eighths inches in length.

Type in the U. S. National Herbarium, no. 1,209,605, collected at Los Mochis, Sinaloa, December 16, 1925, by O. F. Cook and J. W. Hubbard.

The double branching habit, with a vegetative branch and a fruiting branch produced together from the upper nodes of the stalks, is a consistent and characteristic feature not previously recognized in any of the "tree" cottons. The greater tendency to produce vegetative branches is apparent even where the branches are very small, with only two or three leaves, but commonly they have several joints and produce bolls on short secondary fruiting branches. The vegetative branch as a whole is about the same size as the primary fruiting branch of the same node. A similar tendency to

produce two branches from the same node of the stalk has been recognized in the Kehchi cotton of eastern Guatemala.²

Gossypium morrilli, new species

Tall plants bearing numerous long, short-jointed, fruiting branches with 10 to 12 nodes, often maturing bolls at each node, and frequently two bolls from the same node. Some plants very hairy, others notably less, but all distinctly pilose on new growth.

Leaves large dark green, of thin texture, with very broad lobes, strongly up-folded at the sinus; auricles ample, often overlapping on the large leaves; teeth occasionally on midlobes, forelobes and base; length of blade of large leaf, on midrib 15 cm., on auricle 22 cm., width 21 cm., petiole 18 cm.; leaf nectaries 3, even on rather small leaves; stipules rather large.

Involucral bracts broad, distinctly cordate at base, with inner margins united; bractlets occasionally present; pedicels short, triangular in cross section, but not sharply angled; receptacle distinct, but not much swollen around nectaries; outer nectaries often quite large, usually longer than broad, sometimes narrowed to a short groove; calyx lobes sharp-pointed, often tailed.

Flowers white, of very delicate texture; petals with hyaline areas around the yellow oil glands; stamens with long filaments; stigma slightly exerted.

Bolls small, conic-ovoid, with a long acuminate point, mostly with 3 locks, but often with 4; oil glands large and scattering, not interrupted on sutural bands.

Seed very small, black, naked except a small tuft of greenish brown fuzz at base; lint sparse, about 8 inches in length.

This species was obtained by Dr. Morrill from sand-dunes near the coast of southern Sonora in the Yaqui-Valley district.

Type in the U. S. National Herbarium, no. 1,209,603, collected Dec. 16, 1925, from a plant grown at Los Mochis, Sinaloa, by O. F. Cook and J. W. Hubbard.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

935TH MEETING

The 935th meeting was held at the Cosmos Club on Saturday evening, March 20th, 1926. The meeting was called to order by President BOWIE at 8:15 p.m. with 75 persons in attendance.

The program of the evening consisted of an address by Professor MAX BORN of the University at Göttingen, on *New methods in the quantum theory*.

The Bohr-Sommerfeld quantum mechanics, which since 1915 has been used successfully to find the energy and radiation of an atomic system with not more than one electron, is exposed to the objection that it operates with unobservable quantities such as size of the electron orbit, orbital frequency (which is *not* equal to the frequency of the emitted light), and

² See *Weevil-resisting Adaptations of the Cotton Plant*, Bur. Pl. Ind. Bull. 88: 20. 1906.